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GreenGen

—Near Zero Emission Coal Based Power Demonstration Project in China

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- Implementation of GreenGen
- Development plan and technical route of GreenGen
- Building IGCC power plant with independent innovative gasification
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1. Background

China's Energy Consumption mainly based on coal in a long time

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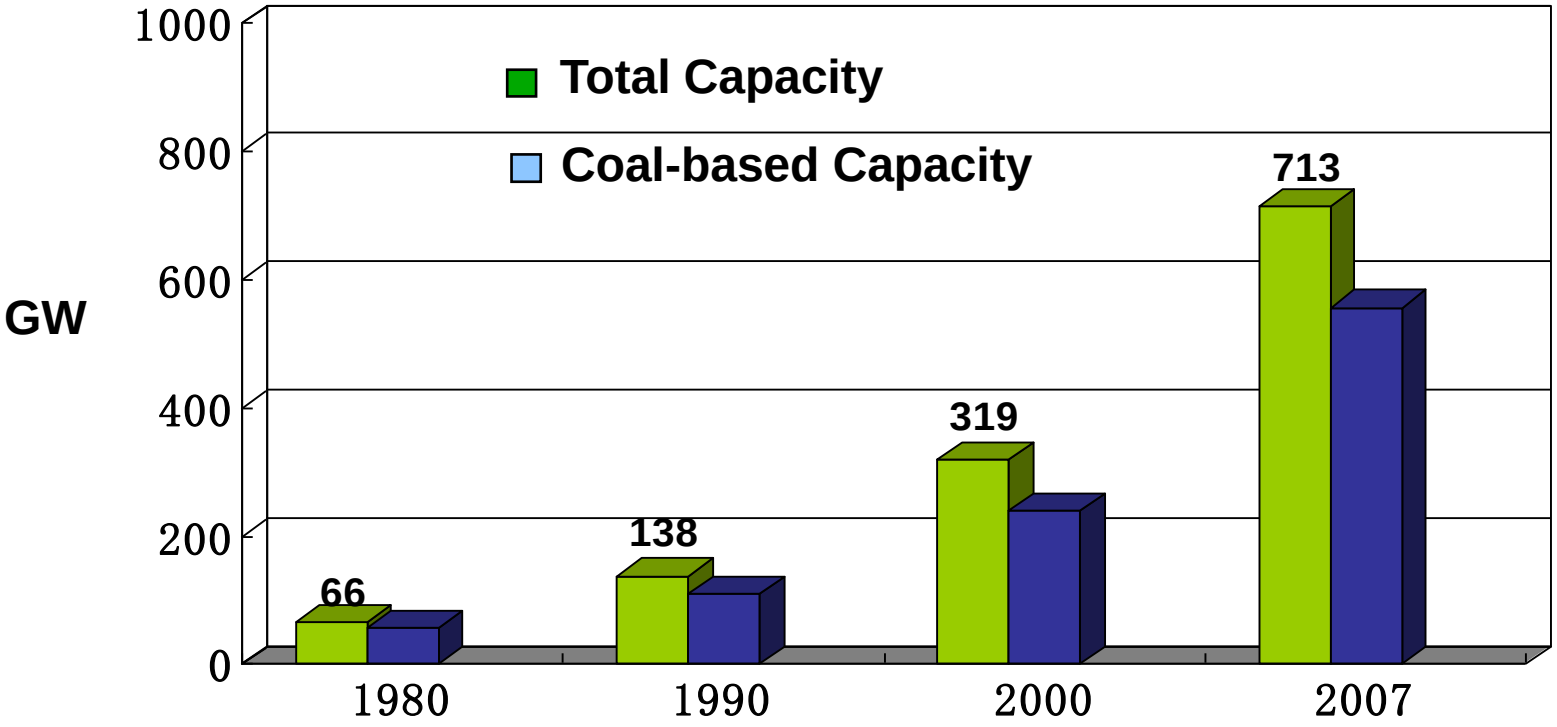

- The installed capacity was excess 713GW in 2007
- In 2007, the proportion of thermal power in the country's installed capacity was about 77.7%

Power Generation is primary CO_2 Emission

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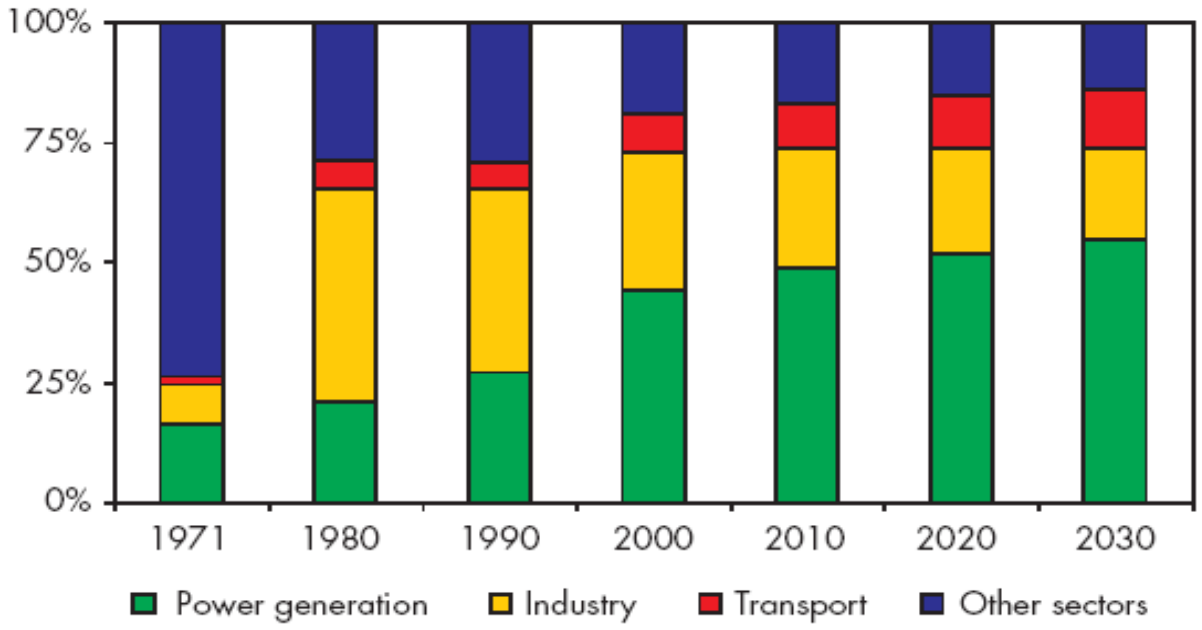


- Power industry is the most important CO_2 emission source. It is about 50% of the total emission in China, and still increases in future

source: IEA, World Energy Outlook 2002

Near Zero Emission Power Projects

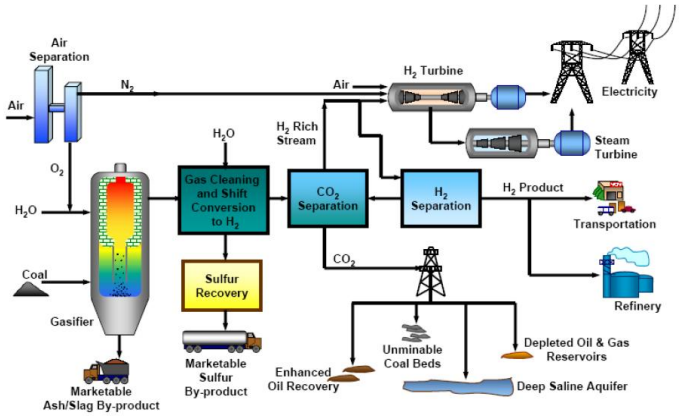
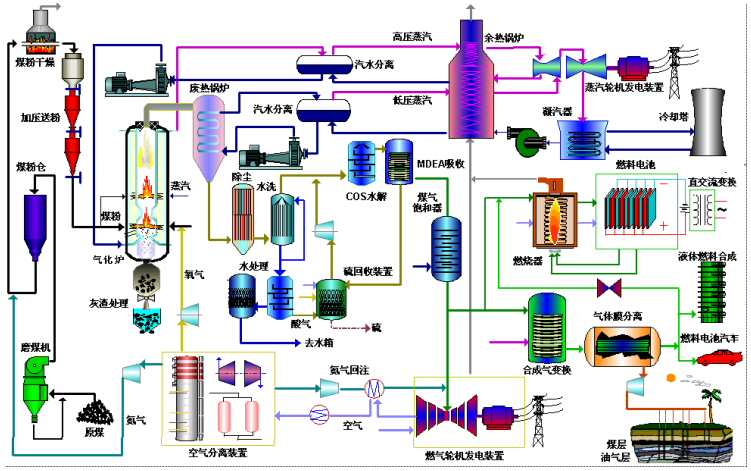


Figure 2.2 - Simplified flow diagram of FutureGen plant (US DOE, 2004)

USA— FutureGen,2003



China— GreenGen,2004

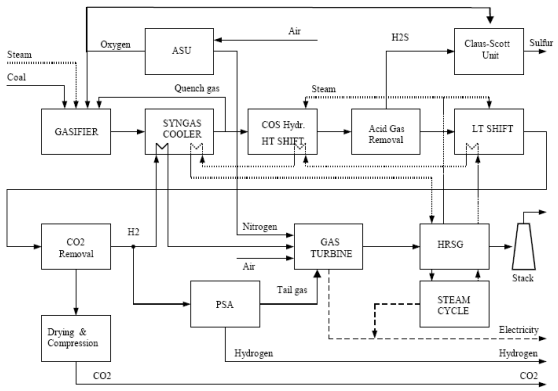
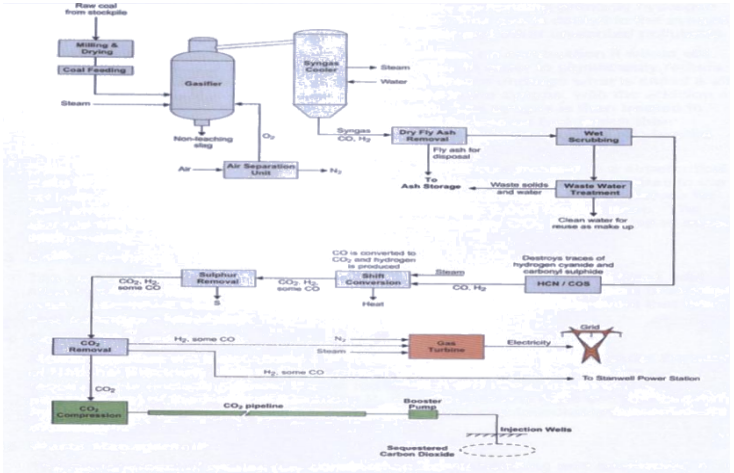


Figure A.1 - Schematic flow diagram of a coal-based Hypogen IGCC plant

EU— HypoGen, 2004



Australia— ZeroGen,2005

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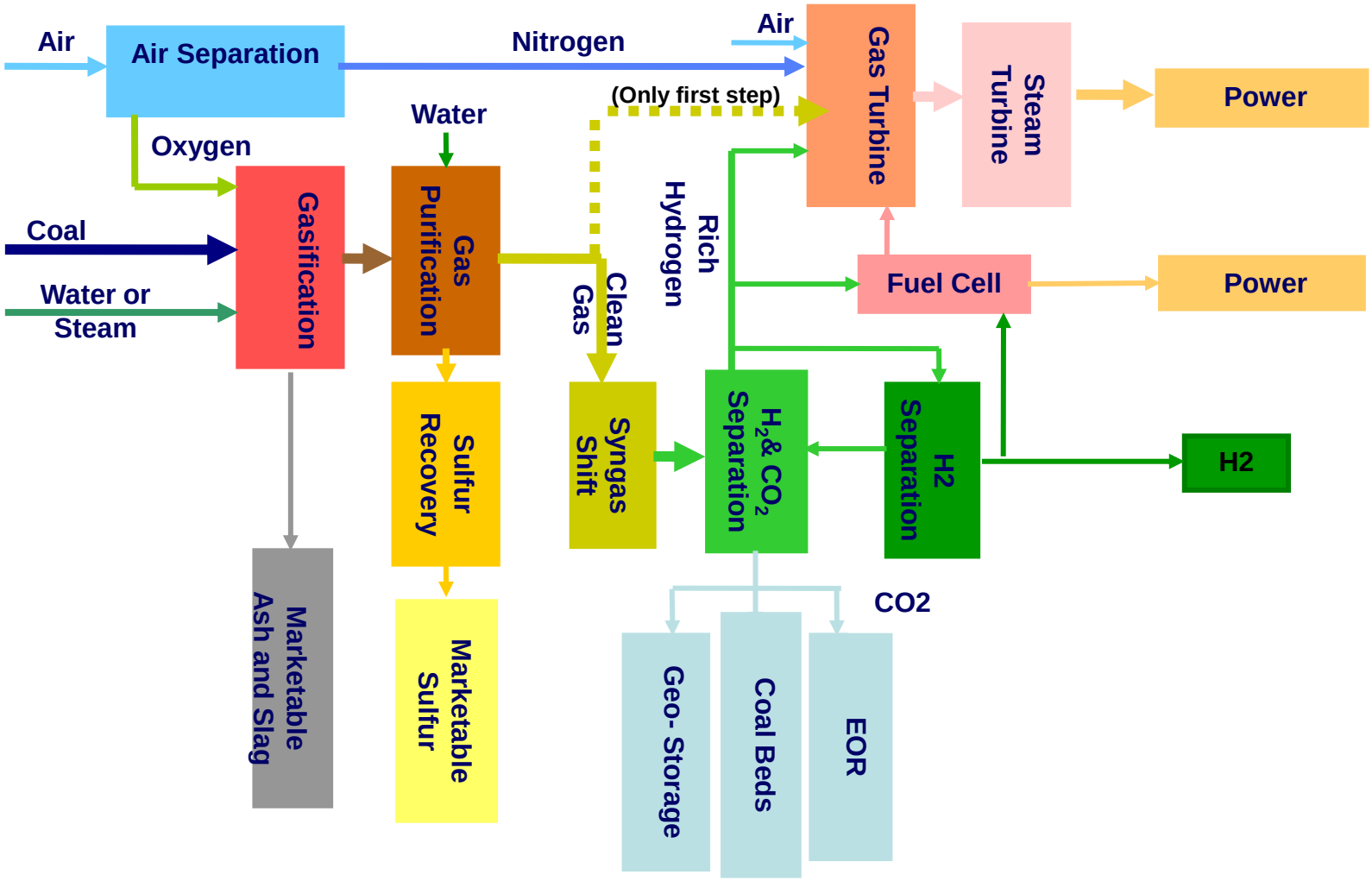
The Flow Sheet of GreenGen



2. Implementation of GreenGen

GreenGen Ltd., Co. was founded

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Under the support of NDRC,MOST and other ministries and commissions, CHNG united other 7 energy enterprises founded the GreenGen Ltd., Co. China .

- China Huaneng Group
- China Datang Group
- China Huadian Corporation
- China Guodian Corporation
- China Power Investment Corporation
- Shenhua Group
- State Development & Investment Co.
- China Coal Group
- Peabody USA

The founder agreement signing ceremony of GreenGen Ltd.

Energy enterprises support environment-friendly ,high efficiency ,Independent innovation

Vice-Premier Zeng Peiyan was meeting principals that attended the GreenGen Ltd. founder agreement signing ceremony

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3. Development plan and technical route of GreenGen

Objective of GreenGen

- To research/develop and demonstrate (RD&D) the integrated coal gasification, hydrogen production, hydrogen power generation and CO_2 sequestration system
- To achieve high coal-based generation efficiency and zero emission of all pollutant and CO_2
- To master the core technologies, sustain technologies and system integration technology and form GreenGen technology with Chinese property right
- To conduct commercial demonstration at acceptable price and realize sustainable development of coal-based generation

Three Stages of the GreenGen

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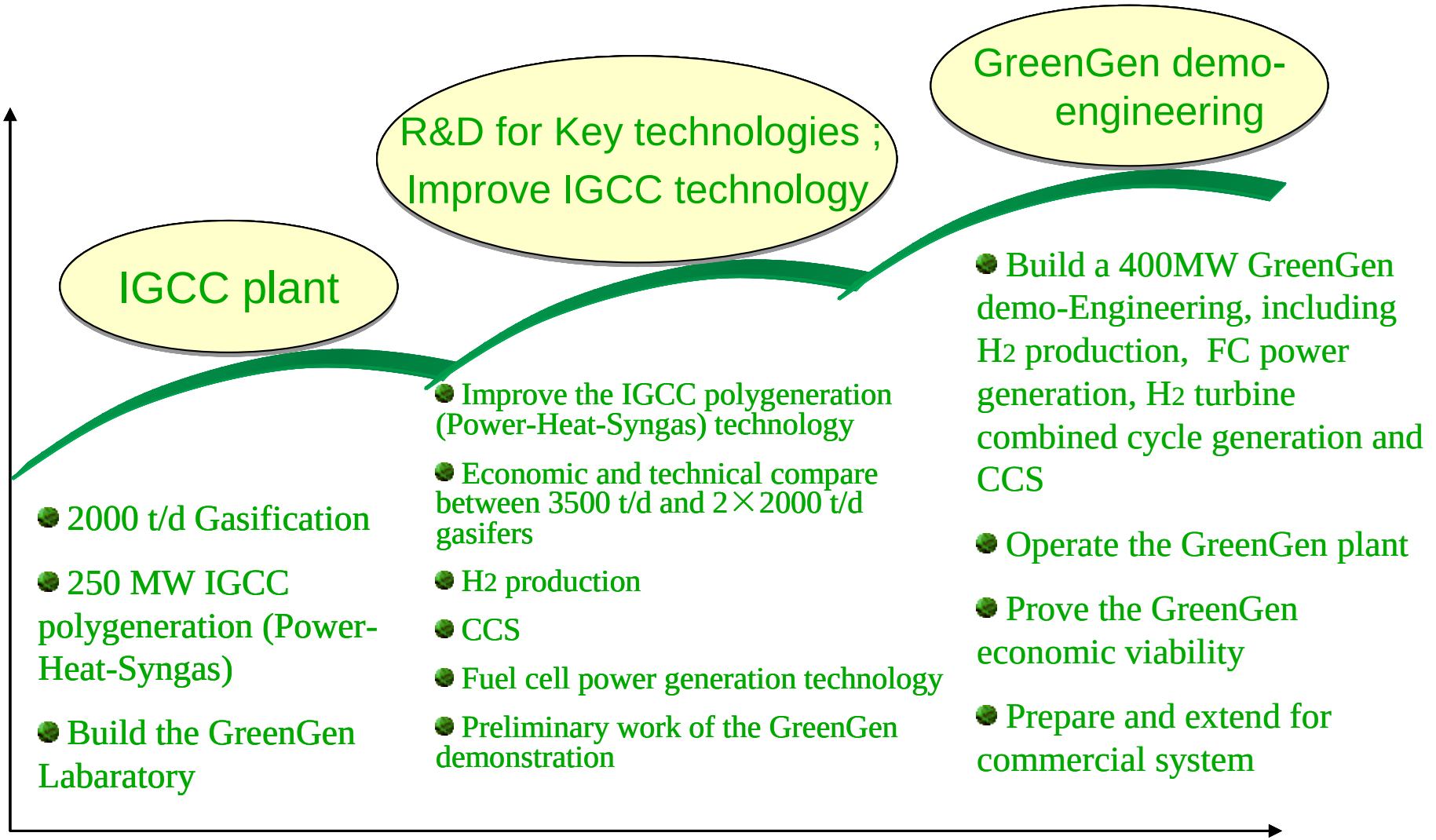

Technical diagram for the stage I

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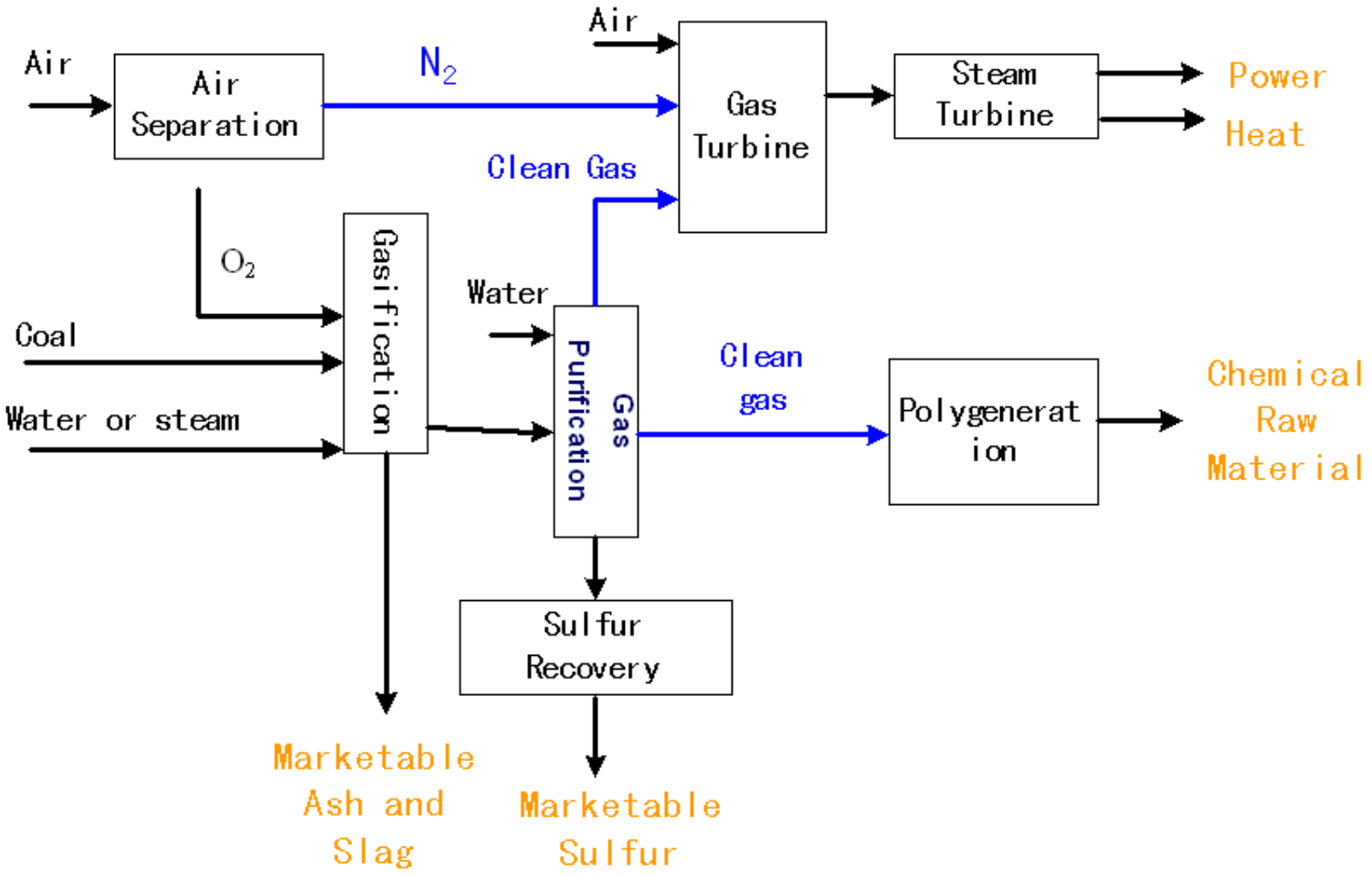
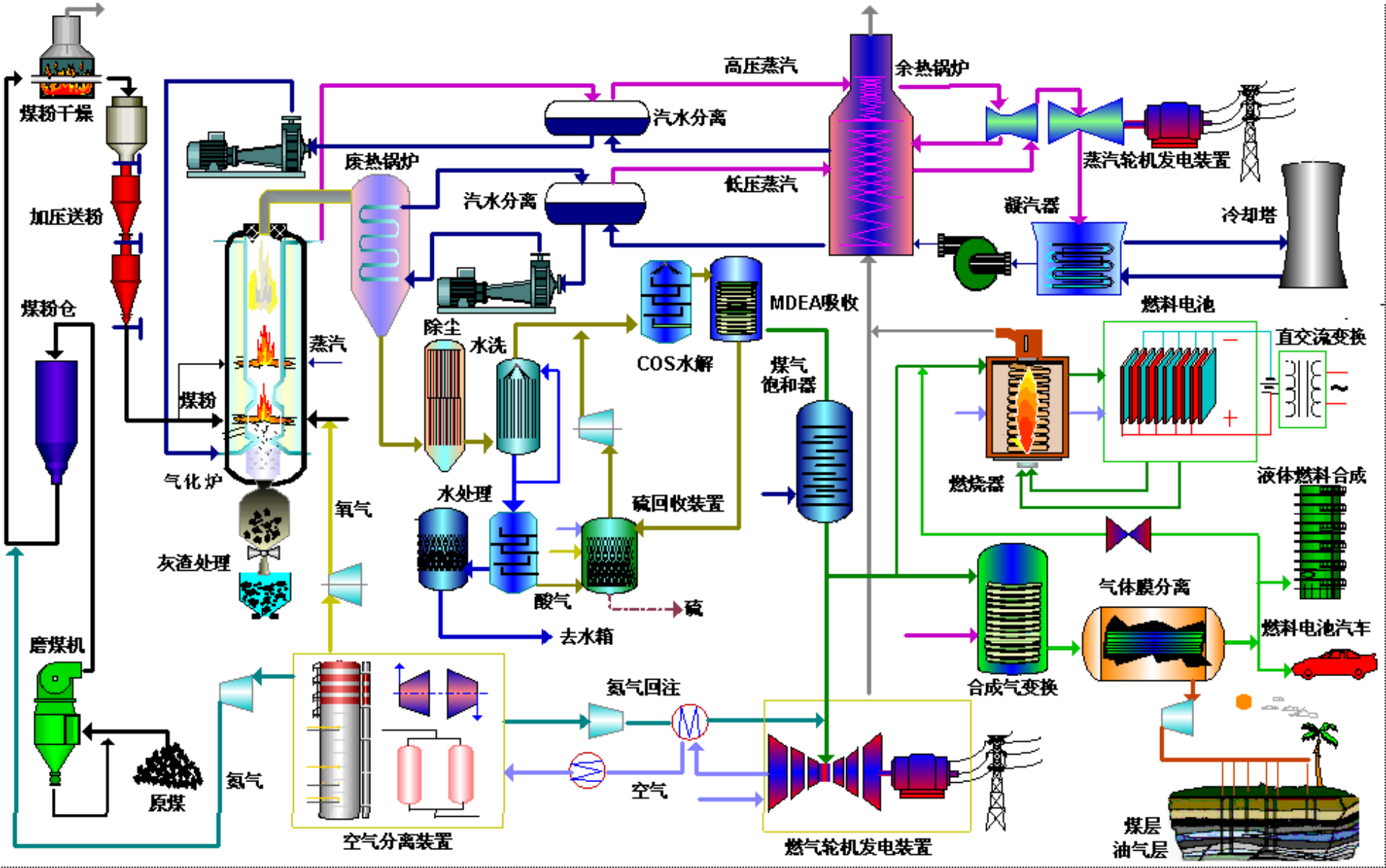
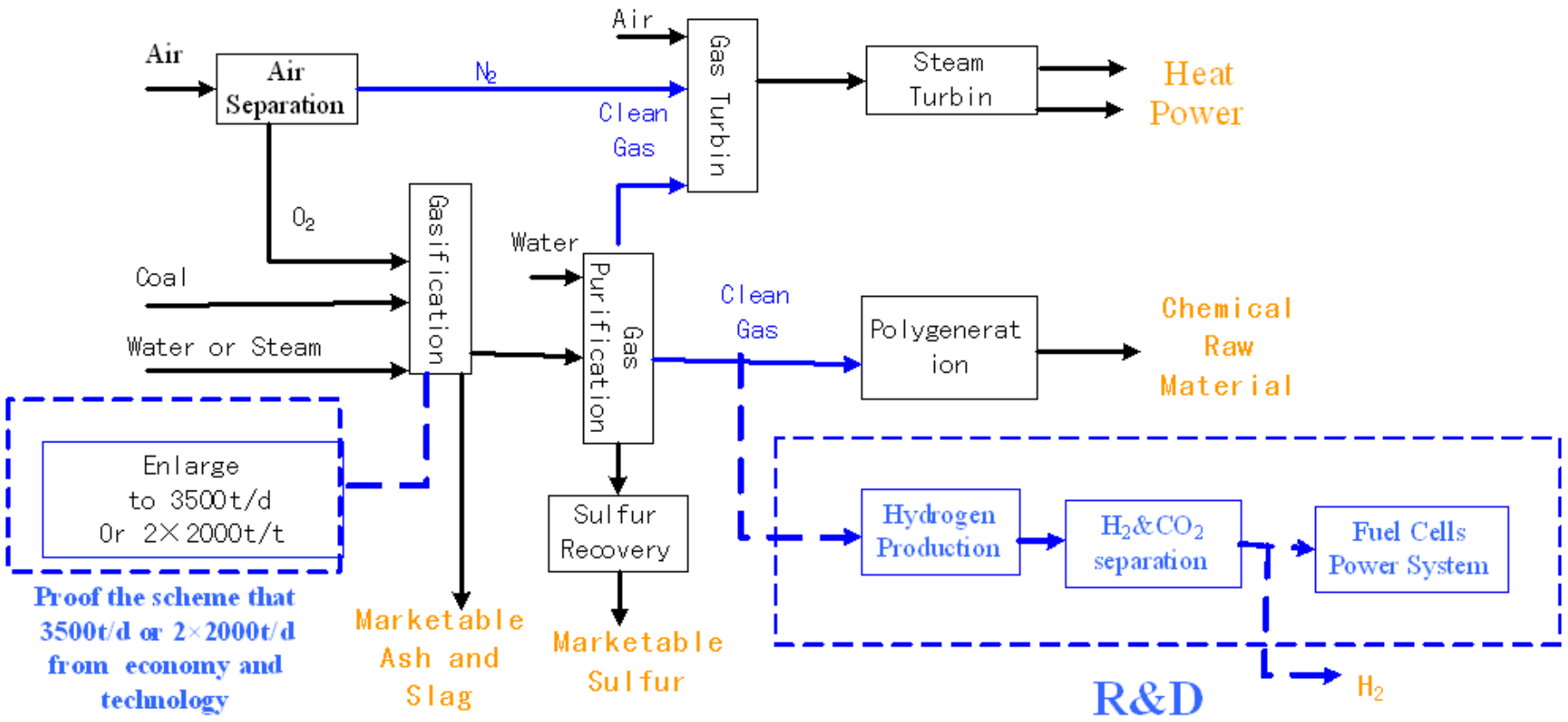


The Flow Sheet of GreenGen I

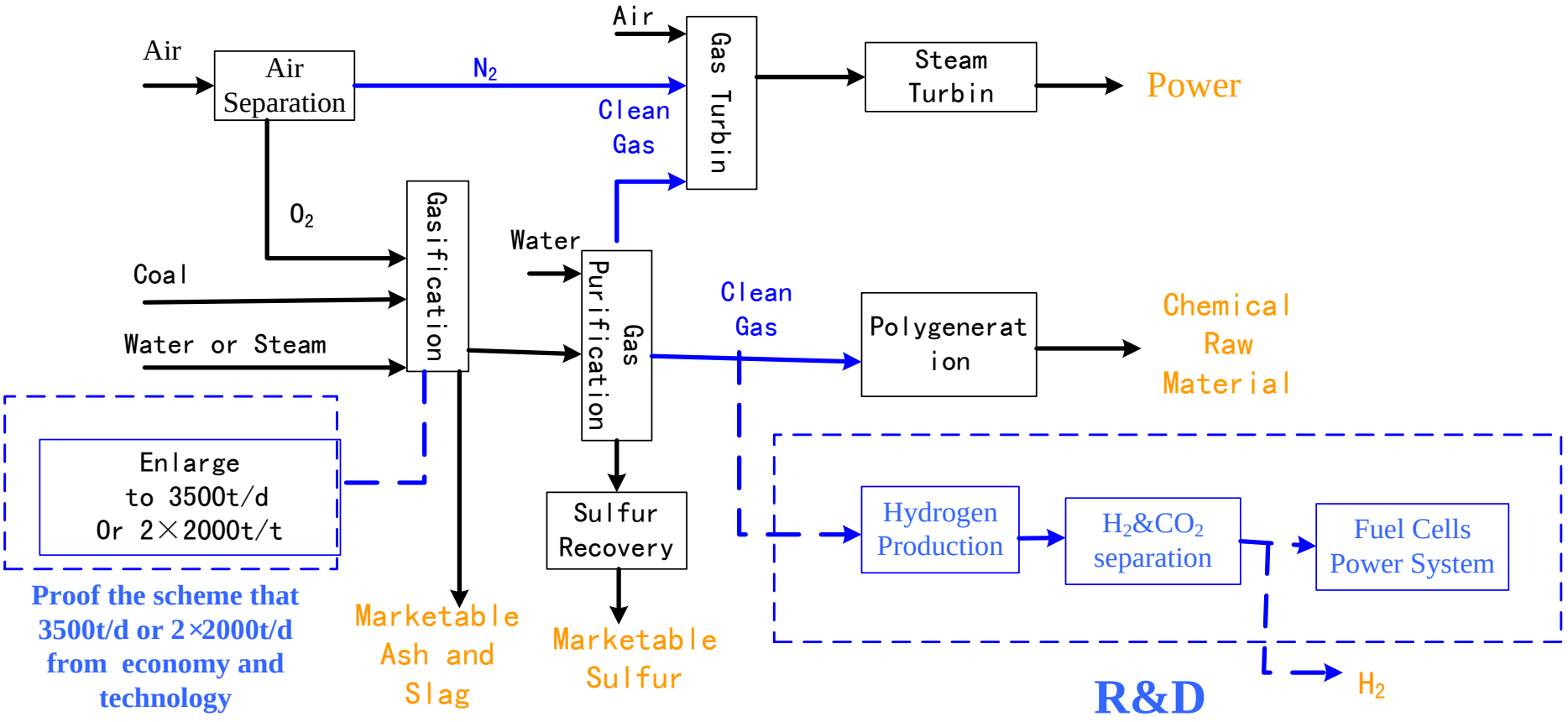


Technical flow diagram for the stage II



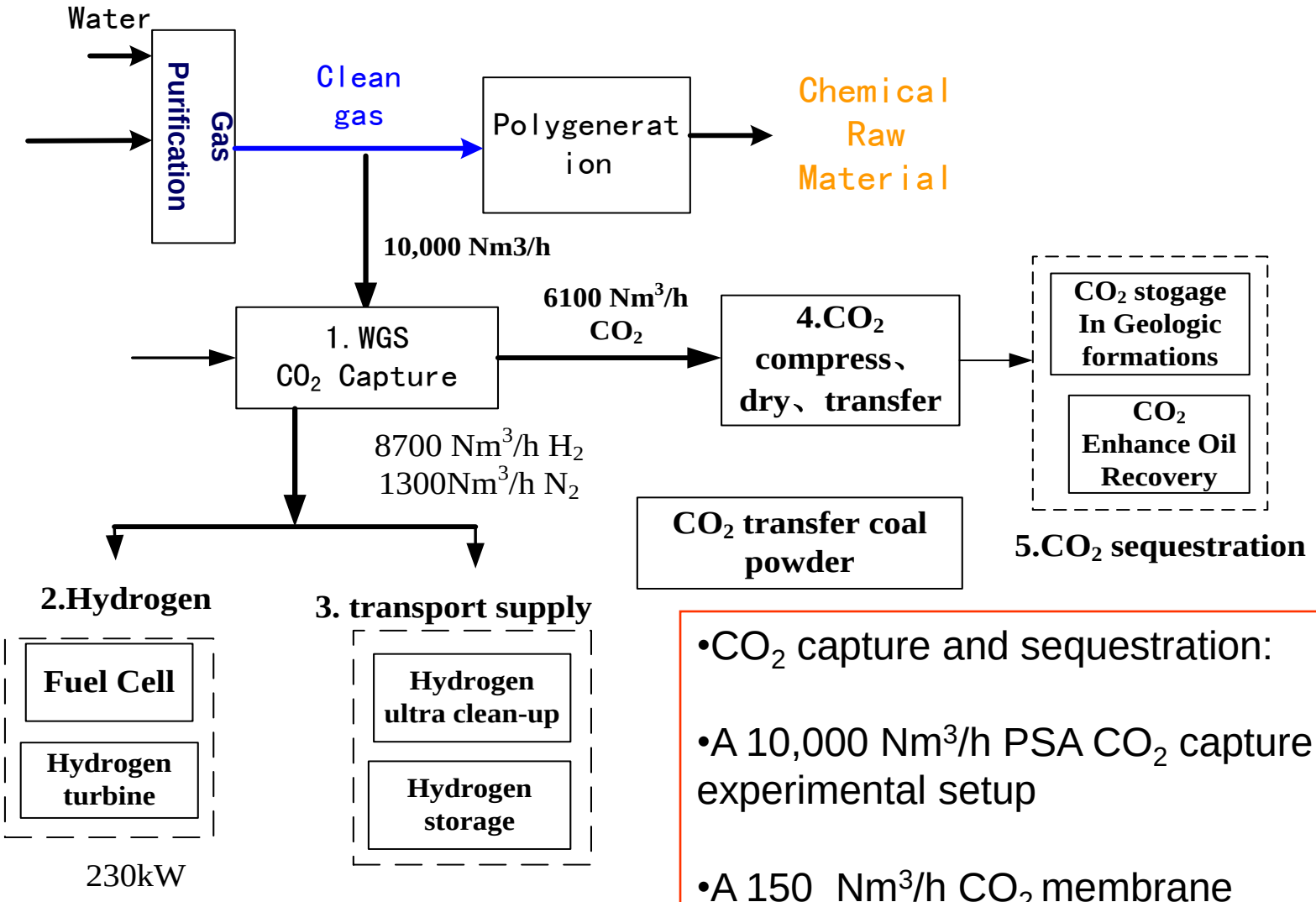
The main tasks in this Stage: Improve & promote IGCC plant and polygeneration; Ready for GreenGen demo engineering

Technical flow diagram for the stage II



The main tasks in this Stage: Improve & promote IGCC plant and polygeneration; Ready for GreenGen demo engineering

GreenGen Pilot Scale System



- CO_2 capture and sequestration:
- A 10,000 Nm^3/h PSA CO_2 capture experimental setup
- A 150 Nm^3/h CO_2 membrane separation capture experimental setup

Technical flow diagram for the stage III

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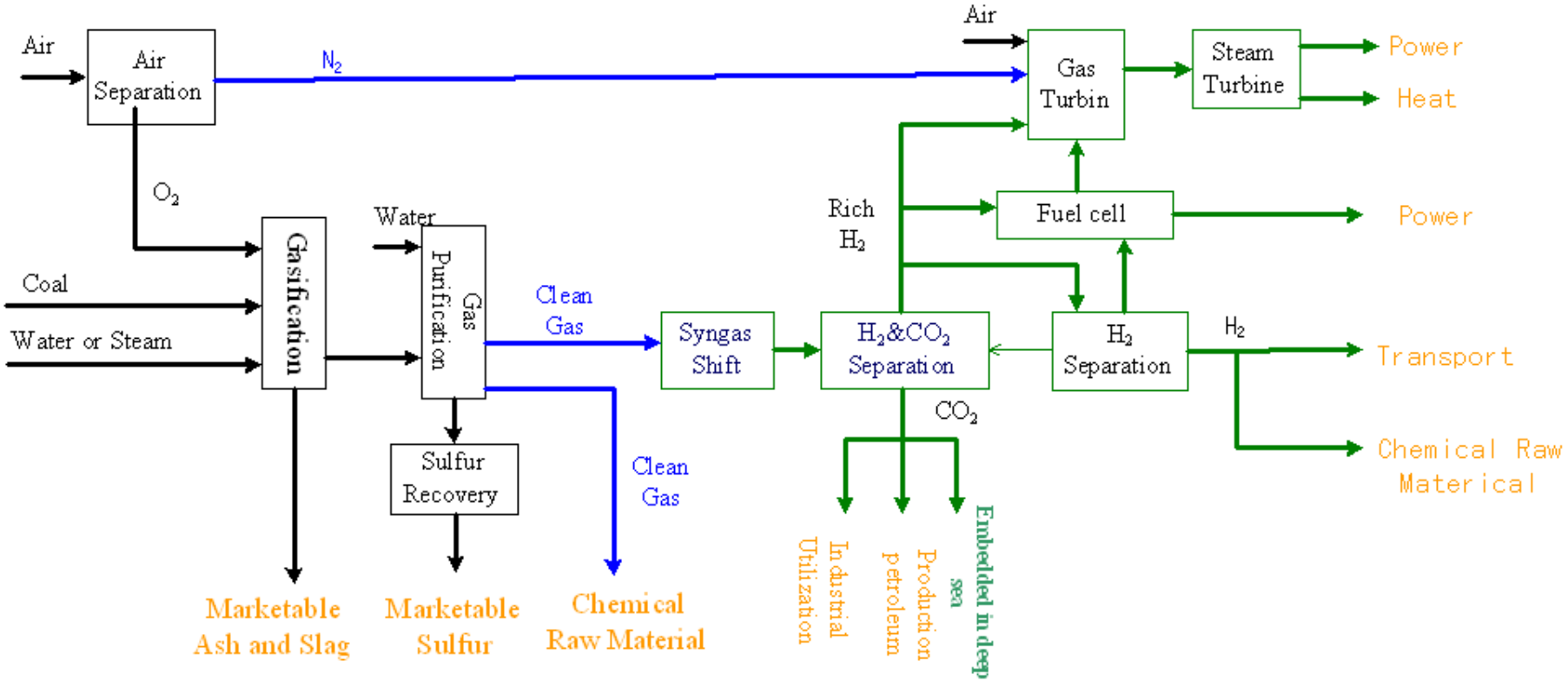
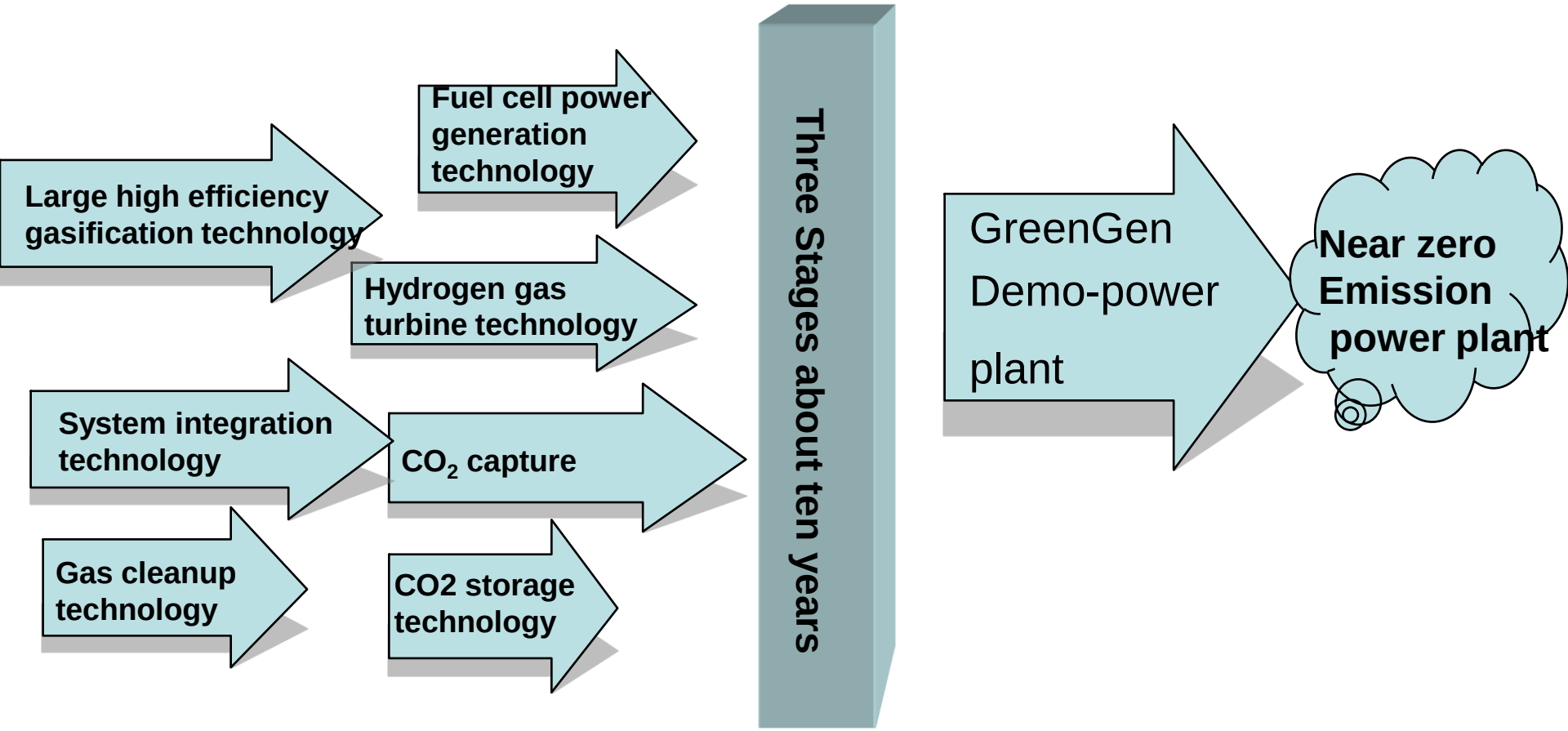


In this stage to realize the final objective of GreenGen in about 2015


中国华能集团绿色煤电示范工程

GreenGen key technologies



4. Building IGCC power plant with independent innovative gasification

IGCC demonstration plant site-Tianjin

Lingang Industrial Park has a number of advantages, including supplies of coal, water and the availability of land. The presence of a large number of chemical plants located in the Industrial Park also creates favorable conditions for the poly-generation system by providing opportunities to utilize the byproducts and a good direct electricity supply.

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IGCC Power Plant -site

The progress of independent innovative Gasfication technology

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Two Stages Gasification with Dry Feed

36 t/d (10 MWth),2004
Funded by MOST

700 kg/d 1996

2000t/d， 2009, MOST, CHNG

GreenGen stage II signing ceremony on April 18th

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CHNG singed the agreement about GreenGen Stage II with the government of Tianjin City ,and will build 2×400 MW IGCC in Tianjin

Main equipment

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1.AUS	Domestic
2.Gasifier	TPRI
3.Gas turbine	Shanghai Electric Group + SIMENS
4.HRSG	Domestic
5.ST	Domestic
6.Integration and Design	TPRI,NECC,NCEDI

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The progress of the project approval

- The IGCC Project has received the 11th five-year plan 863 major projects support from Ministry of Science and Technology (MOST)
- The Project received the Access system application approval from State grid in Jun. 2007
- The Project received Environmental Impact Assessment (EIA) of the project approval from State Environmental Protection Administration (SEPA) in July 2007
- The project has received the all 27 support documents for the project approval
- The project has received the feasible final report approval from National Electric Power Planning and Design Institute in Aug. 2007

5. The CCS R&D projects

CO_2 capture technology for power plants

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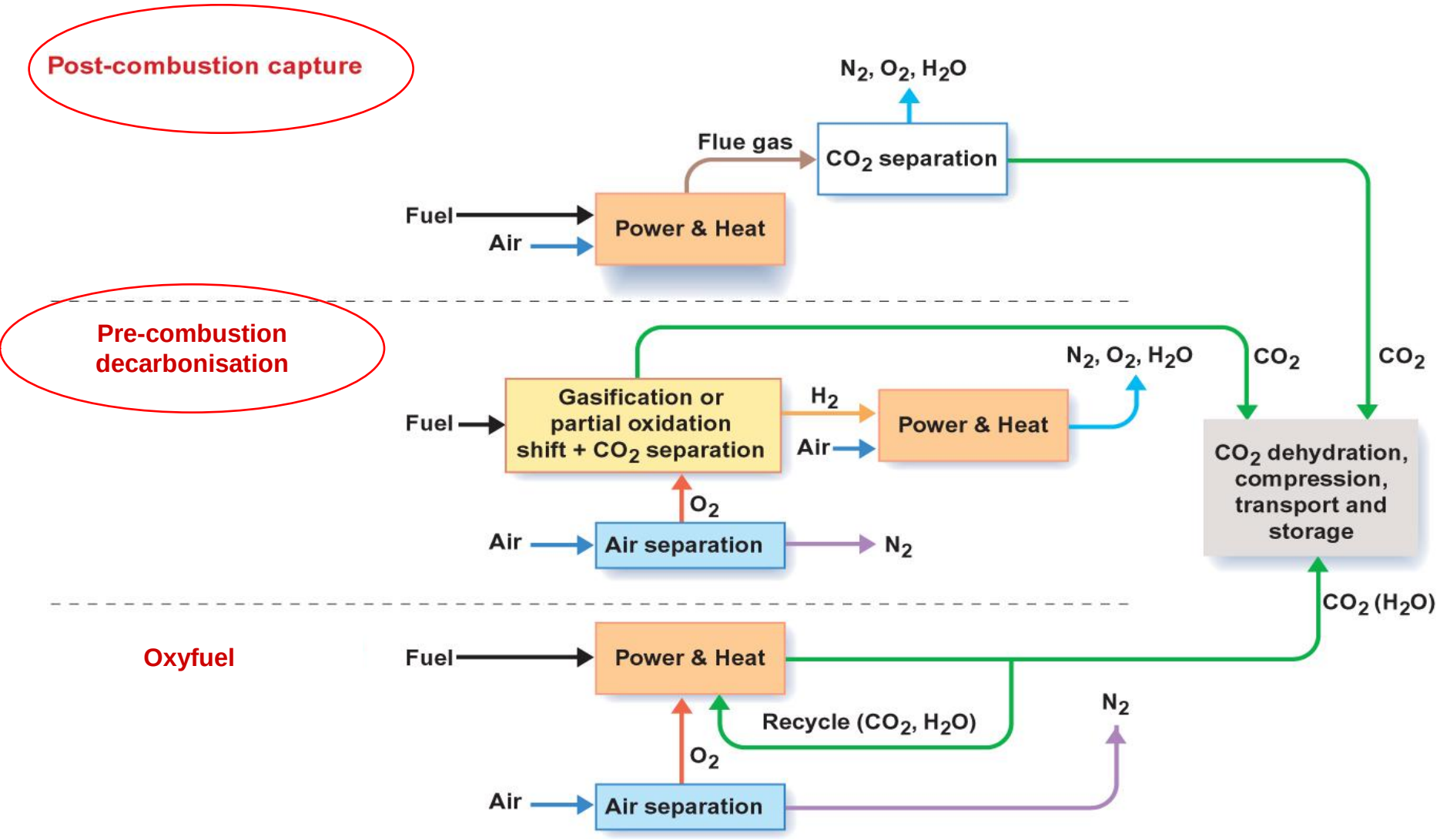

Post-combustion CCS Project

- 3000～5000t/a PCC will be build in CHNG Beijing Thermal Power Plant, will be operational by July 2008

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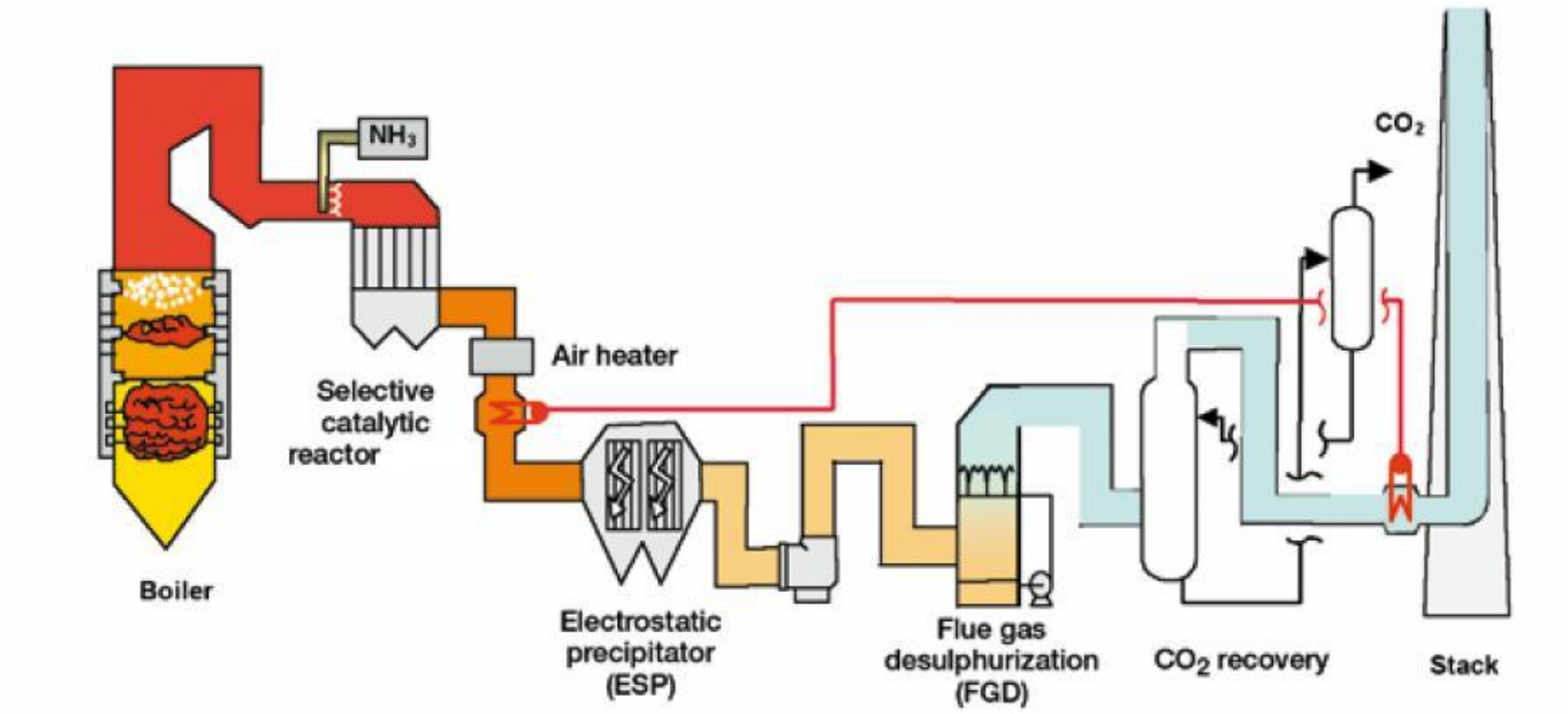
燃烧后脱除CO_2系统流程 （Post-combustion)



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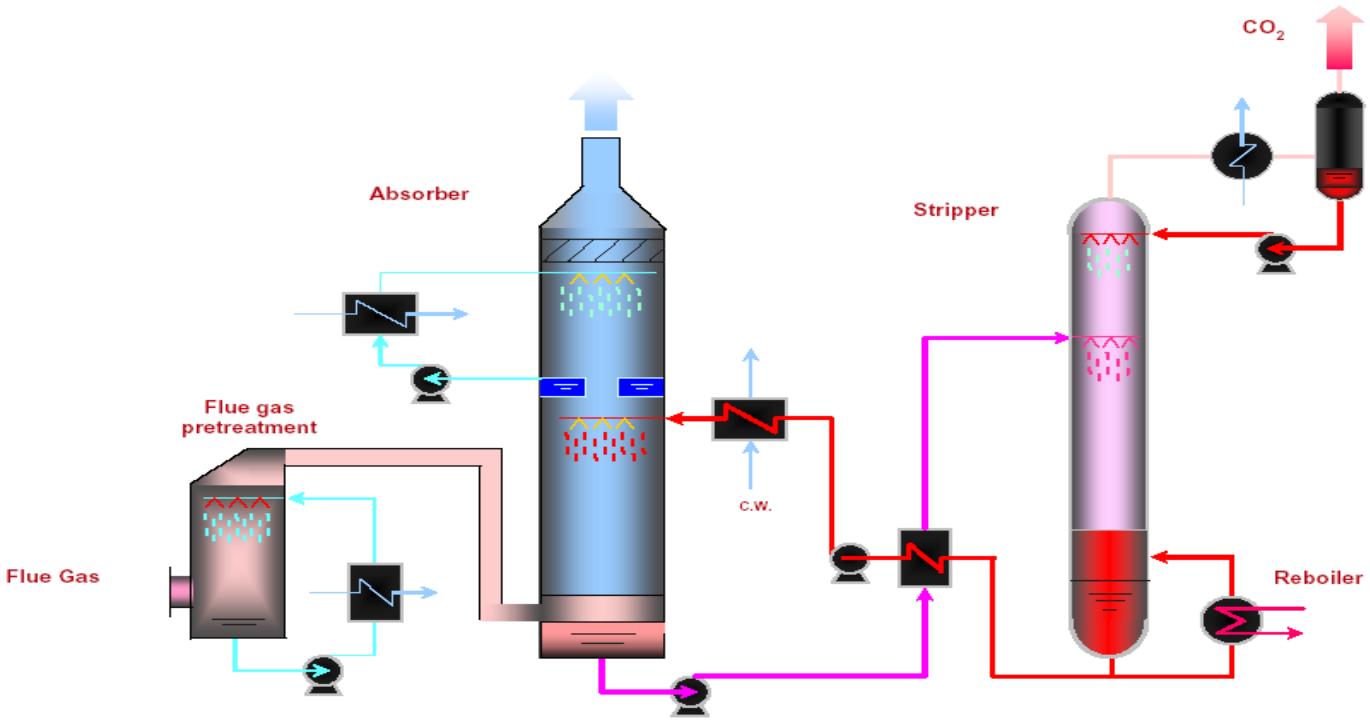

3000～5000t/a PCC will be build in CHNG Beijing

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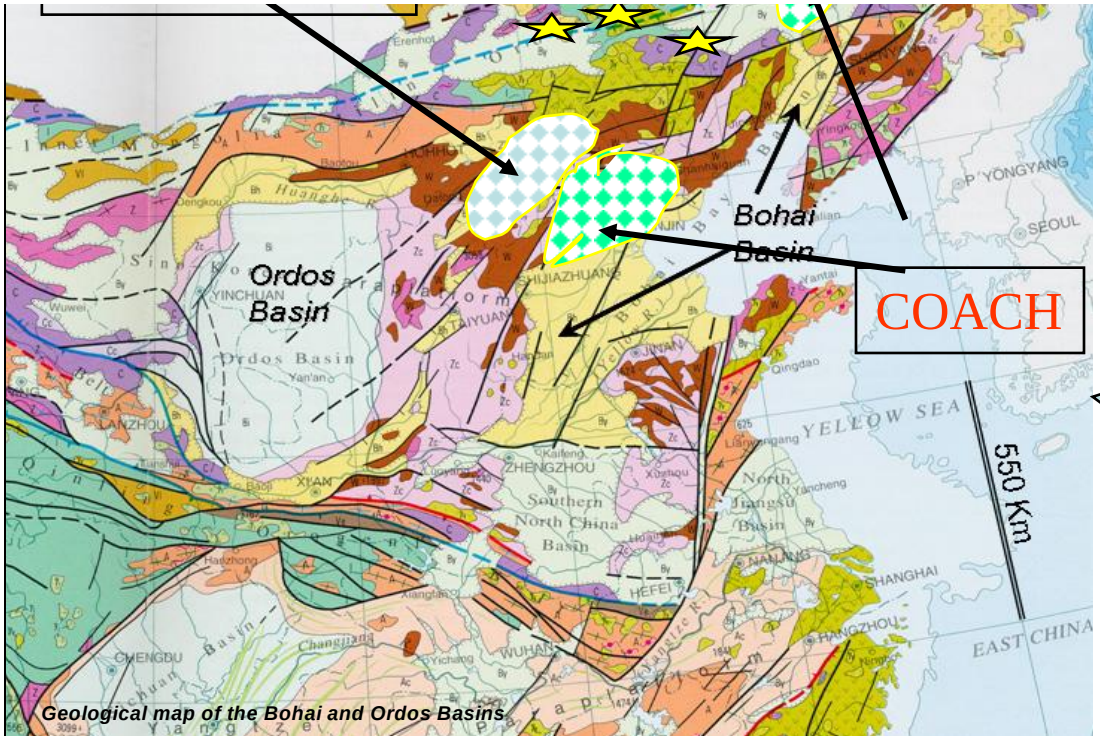
- TPRI joined the COACH (Cooperation Action within CCS China-EU)

- TPRI joined the cooperation with UK for CO_2 capture and sequestration (NEZC)

- GreenGen project will play important role in the both COACH and NEZC



Geological map of the Bohai and Ordos Basins

CO_2 storage in deep geologic formation and enhance oil recovery

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Summary

- China's energy structure requires to develop GreenGen for sustainable development;
- With leadership from NDRC and MOST, we believe the GreenGen program will be carried out successfully
- Gasification and other technologies of domestic and overseas enterprises supply the solid fundament of GreenGen program
- The IGCC power plant has been located in Tianjin, and received the national major project support; the agreement about stage II has been signed between Tianjing and CHNG, and main equipment biddings will be finished recently
- The project has received all support documents, the feasible final report and EIA approval.
- Besides the GreenGen project, CHNG is researching and developing the other CO_2 capture technologies.

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